Article

A Analysis of the Causes of "High Use - Low Effectiveness" in Digital Textbooks: An Explanation Based on the Structure of Learning Behavior

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Abstract: Digital textbooks have become increasingly prevalent in educational settings, yet their widespread adoption has not consistently translated into improved learning outcomes. This research article explores the phenomenon of 'High Use - Low Effectiveness' in digital textbooks, focusing on the structural dynamics of learning behavior as a key explanatory framework. By analyzing user engagement patterns, cognitive load factors, and pedagogical alignment, this study aims to identify critical barriers and propose actionable strategies for optimizing the efficacy of digital textbooks in diverse learning environments.

Keywords: digital textbooks; learning behavior; effectiveness; cognitive load; educational technology

1. Introduction

1.1. Background and Context

The rapid digital transformation in education has fundamentally reshaped the tools and resources available for teaching and learning. Among these innovations, digital textbooks have emerged as a prominent feature, offering interactive content, multimedia integration, and accessibility across diverse platforms. Their widespread adoption has been driven by the promise of enhancing educational outcomes, facilitating personalized learning experiences, and bridging gaps in resource availability. Institutions and educators have increasingly integrated these tools into curricula, encouraged by the belief that digital formats inherently improve engagement and comprehension. This shift aligns with broader societal trends emphasizing the role of technology in modernizing traditional practices.

However, despite the high frequency and extended duration of digital textbook usage observed among students, a paradox has emerged: this "high usage" does not consistently translate into proportional improvements in academic performance or the development of higher-order thinking skills. While students spend significant amounts of time interacting with digital textbooks, the expected gains in understanding, critical analysis, and problem-solving often remain elusive. This phenomenon challenges the assumption that increased exposure to digital resources automatically enhances learning outcomes. Instead, it suggests a disconnect between the technological medium and the cognitive processes required for effective learning.

This paradox highlights the limitations of the traditional perspective of technological determinism, which posits that the mere presence and use of technology inherently drive progress [1]. In practice, this deterministic view has often failed to account for the complexities of learning behavior and the nuanced interplay between technology, pedagogy, and student engagement [2]. The reliance on digital textbooks as a solution to

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educational challenges may overlook critical factors such as the quality of instructional design, the alignment of content with learning objectives, and the strategies employed by students to interact with these resources. Consequently, understanding the structural causes behind this "high use--low effectiveness" dynamic requires a deeper examination of how digital textbooks are utilized within the broader framework of learning behavior.

1.2. Research Objectives

The primary objective of this study is to investigate the underlying mechanisms that contribute to the observed disparity between the high usage rates of digital textbooks and their limited effectiveness in improving learning outcomes. This phenomenon, often referred to as "High Usage - Low Efficacy," highlights a critical gap in understanding how technological tools interact with the learning process. While prior research has extensively explored the technological affordances of digital textbooks and their potential to enhance education, the connection between these tools and measurable learning outcomes remains insufficiently explained. This study aims to address this gap by opening the "black box" that links technology use to learning efficacy, focusing specifically on the structure of learning behavior as the missing link.

The concept of "Learning Behavior Structure" is proposed as a framework to bridge this gap [3]. Unlike traditional approaches that emphasize either technological features or surface-level user engagement, this study posits that learning behaviors must be decomposed into three interrelated dimensions: cognitive, interactive, and regulatory. The cognitive dimension pertains to how learners process and internalize information, including activities such as reading, summarizing, and critical thinking. The interactive dimension examines the social and collaborative aspects of learning, including peer discussions, feedback exchanges, and interactions with digital content [4]. Finally, the regulatory dimension focuses on self-regulation and metacognitive strategies, such as goal setting, time management, and monitoring progress. By analyzing these dimensions collectively, this study seeks to uncover the nuanced ways in which digital textbook use influences learning outcomes [3].

The ultimate goal of this research is to provide a comprehensive explanation of the "High Usage - Low Efficacy" phenomenon by identifying the structural factors within learning behaviors that mediate the relationship between technology use and educational effectiveness. Through this decomposition, the study aims to offer actionable insights for both educators and developers of digital learning tools, enabling the design of more effective interventions that align with the cognitive, interactive, and regulatory needs of learners.

2. Literature Review

2.1. Previous Studies on Digital Textbooks

The adoption of digital textbooks has been extensively studied in recent years, with researchers exploring their potential to enhance learning outcomes and engagement. Previous research indicates that digital textbooks offer advantages such as portability, interactive features, and multimedia integration, which are believed to facilitate deeper understanding and retention [5, 6]. Some studies suggest that these tools can improve student motivation and provide personalized learning experiences through adaptive technologies. Furthermore, the ability to access vast amounts of information instantaneously is often highlighted as a key benefit, aligning with the needs of modern learners in digital environments.

However, conflicting findings have emerged regarding the actual impact of digital textbooks on learning effectiveness [7, 8]. While some studies report positive outcomes, such as improved comprehension and academic performance, others find little to no significant difference when compared to traditional textbooks. Moreover, certain research highlights potential drawbacks, including cognitive overload caused by excessive multimedia elements and the distraction posed by non-educational digital features. These inconsistencies suggest that the effectiveness of digital textbooks may depend on factors

beyond mere adoption, such as the specific ways in which students interact with these resources.

A notable gap in the existing literature is the tendency to treat digital textbook usage as a singular, undifferentiated variable. Most studies focus on measuring overall adoption rates or time spent using digital textbooks, without delving into the nuances of how students engage with these tools. For instance, the distinction between passive consumption of content and active interaction with embedded features remains underexplored. Understanding the structure of learning behavior in relation to digital textbook usage could provide critical insights into why high usage does not always translate into high effectiveness, thereby addressing the inconsistencies observed in current findings.

2.2. Theoretical Frameworks on Learning Behavior

The structure of learning behavior in the context of digital textbook usage can be understood through three interconnected dimensions: cognitive behavior, interactive behavior, and regulatory behavior. Cognitive behavior refers to the processes involved in information processing, such as browsing, highlighting, and organizing content. Previous research indicates that effective cognitive engagement with digital textbooks enhances comprehension and retention, as these activities facilitate the encoding and retrieval of information [9, 10]. As illustrated in Figure 1, digital textbook usage is hypothesized to positively influence cognitive behavior (H1), suggesting that higher engagement with digital tools may lead to more frequent and effective cognitive strategies [4, 11].

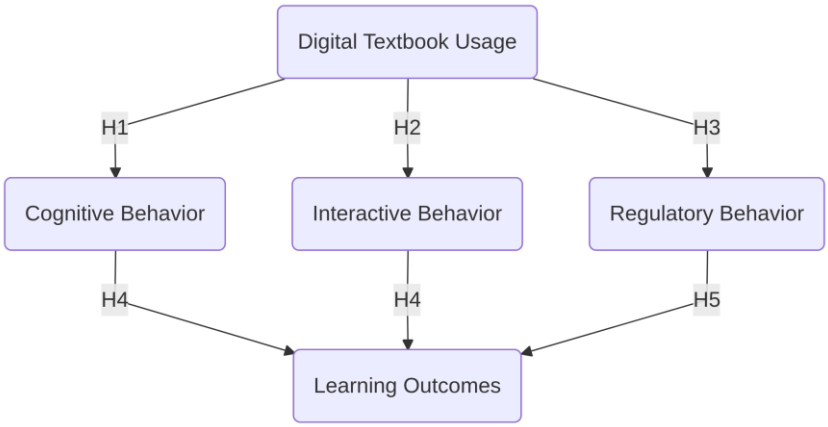

Figure 1. Theoretical Hypothesis Model of Learning Behavior Structure

Interactive behavior encompasses social cognition, including peer discussion, collaborative learning, and the sharing of annotations. Digital textbooks often provide interactive features that enable users to exchange ideas, comment on shared notes, and engage in group discussions. These behaviors are critical for fostering deeper understanding and promoting the co-construction of knowledge. Figure 1 highlights the hypothesized relationship between digital textbook usage and interactive behavior (H2), proposing that increased usage facilitates social interactions that contribute to enhanced learning outcomes. Furthermore, interactive behavior is posited to mediate the relationship between usage and learning outcomes (H4), emphasizing its role as a conduit for translating engagement into academic success.

Regulatory behavior involves self-regulation strategies such as goal setting, progress monitoring, and time management. These behaviors are essential for maintaining focus and ensuring that learning objectives are met. Digital textbooks often include tools that support self-regulation, such as progress tracking dashboards and personalized learning paths. According to Figure 1, digital textbook usage is hypothesized to positively impact regulatory behavior (H3), with self-regulation serving as a critical mediator between

usage and learning outcomes (H5). This suggests that the ability to effectively manage one's learning process is a key factor in achieving meaningful educational results.

In summary, the theoretical framework presented in Figure 1 underscores the importance of cognitive, interactive, and regulatory behaviors in mediating the relationship between digital textbook usage and learning outcomes. It is hypothesized that usage positively influences all three dimensions, which in turn contribute to improved academic performance. These interdependencies highlight the need for a holistic approach to understanding the mechanisms underlying the effectiveness of digital textbooks.

3. Materials and Methods

3.1. Study Design

The study employed a quantitative research design centered on survey methodology and Structural Equation Modeling (SEM) to investigate the underlying causes of "high use - low effectiveness" in digital textbooks. As depicted in Figure 2, the research process was systematically structured into five sequential stages: literature review and hypothesis generation, questionnaire design and pilot testing, main data collection, SEM data analysis, and the derivation of conclusions and implications. This flowchart underscores the iterative nature of the study, where theoretical insights informed the development of hypotheses, which were subsequently operationalized through a carefully constructed survey instrument.

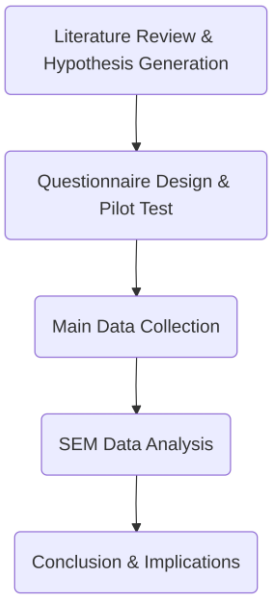

Figure 2. Flowchart of the Research Design and Procedure.

The rationale for utilizing SEM lies in its ability to model complex, multi-dimensional relationships within the structure of learning behavior [7]. Digital textbook usage involves interconnected behavioral, cognitive, and motivational dimensions, which traditional statistical methods may struggle to capture comprehensively. SEM offers a robust framework for examining these latent constructs and their interdependencies, allowing for the simultaneous testing of direct, indirect, and mediating effects. This is particularly critical for exploring how specific aspects of learning behavior mediate the relationship between digital textbook engagement and educational outcomes.

Furthermore, the pilot testing phase ensured the reliability and validity of the survey instrument, which was designed to measure constructs such as engagement intensity, cognitive processing strategies, and perceived effectiveness. The main data collection phase provided a large dataset suitable for SEM analysis, enabling the identification of statistically significant pathways and the validation of hypothesized relationships. As

illustrated in Figure 2, the integration of SEM into the research design facilitated a nuanced understanding of the structural dynamics underlying learning behaviors, thereby addressing the study's central research question.

3.2. Data Collection

The data collection process employed a stratified random sampling method to ensure representation across key demographic and behavioral variables. The target population consisted of middle and high school students, as these groups represent a critical segment of digital textbook users in formal education. Participants were recruited from multiple schools within urban and suburban regions to capture a diverse range of learning environments and access levels to digital resources [6]. As detailed in Table 1, the sample included a balanced distribution of gender (Male: 48.5%, Female: 51.5%) and grade levels (Middle School: 55.0%, High School: 45.0%). Additionally, participants were categorized based on their average daily usage of digital textbooks, with usage segmented into three groups: less than 1 hour, 1--3 hours, and more than 3 hours (30.2%, 45.8%, and 24%, respectively).

Table 1. Participant Demographics and Descriptive Statistics

Demographic/Metric	Category/Group	Percentage (%)	Mean ± SD (if applicable)
Gender Distribution	Male	48.5	-
	Female	51.5	-
Grade Level Distribution	Middle School	55.0	-
	High School	45.0	-
Daily Digital Textbook Usage	< 1 hour	30.2	-
	1–3 hours	45.8	-
	> 3 hours	24.0	-
Cognitive Engagement (Likert)	-	-	4.2 ± 0.6
Behavioral Engagement (Likert)	-	-	3.9 ± 0.7
Metacognitive Strategies (Likert)	-	-	4.1 ± 0.5
Learning Efficacy (Likert)	-	-	4.3 ± 0.4

Data were gathered through a structured online survey administered during regular school hours, ensuring a controlled environment for consistent responses. The survey instrument included items designed to measure Digital Textbook Usage, Learning Behaviors, and Learning Efficacy. Digital Textbook Usage was assessed by asking participants to report their frequency and duration of use, as well as the types of activities performed using digital textbooks. Learning Behaviors were operationalized into three dimensions: cognitive engagement, behavioral engagement, and metacognitive strategies. Each dimension was measured using a series of statements rated on a 5-point Likert scale, ranging from 1 (strongly disagree) to 5 (strongly agree). Learning Efficacy was similarly evaluated using a 5-point Likert scale, with items focusing on students' perceived understanding, retention, and application of content learned through digital textbooks. This multi-dimensional approach ensured comprehensive data collection to support subsequent analyses.

3.3. Analytical Techniques

To analyze the causes of "high use - low effectiveness" in digital textbooks, a combination of statistical and structural modeling techniques was employed. Descriptive statistics and correlation analyses were conducted using SPSS to provide an overview of the dataset and examine the relationships between key variables. These preliminary analyses offered insights into the distribution, central tendencies, and inter-variable associations, forming the basis for subsequent modeling. For evaluating the measurement model and structural relationships, AMOS and SmartPLS were utilized. The measurement model assessment focused on reliability and validity, ensuring that the constructs were both internally consistent and accurately represented the theoretical framework. Reliability was evaluated through Cronbach's Alpha and Composite Reliability (CR), while validity was assessed using Average Variance Extracted (AVE). As detailed in Table 2, all constructs demonstrated satisfactory reliability and convergent validity, with Cronbach's Alpha and CR values exceeding 0.8 and AVE values surpassing the threshold of 0.5. For instance, the construct "Digital Textbook Usage" comprised four items, each meeting these criteria, while "Cognitive Behavior" and "Interactive Behavior" similarly exhibited robust reliability and validity across their respective items.

Table 2. Reliability and Convergent Validity of Measurement Constructs

Construct	Cronbach's Alpha (α)	Composite Reliability (CR)	Average Variance Extracted (AVE)
Digital Textbook Usage	0.85	0.88	0.62
Cognitive Behavior	0.89	0.91	0.68
Interactive Behavior	0.87	0.90	0.65
Learning Effectiveness	0.92	0.94	0.72
Engagement	0.86	0.89	0.64

Path analysis was then conducted using structural equation modeling to examine the relationships between constructs within the structural model. This approach allowed for the testing of hypothesized causal pathways and the identification of significant predictors of learning effectiveness [5]. The integration of these analytical techniques ensured a comprehensive examination of the data, providing both descriptive insights and a robust evaluation of the theoretical model underpinning the study.

4. Results

4.1. Patterns of Usage

Analysis of usage patterns reveals distinct disparities in the engagement levels across different dimensions of learning behaviors when utilizing digital textbooks. Descriptive data indicates that students exhibit high frequency in accessing digital textbooks, with a predominant focus on basic cognitive behaviors such as reading and reviewing textual content. As illustrated in Figure 3, the Likert scale diverging bar chart demonstrates a pronounced skew toward agreement for questionnaire items related to cognitive behaviors. This suggests that students consistently engage with fundamental tasks like reading and comprehending text, which are essential for basic information acquisition.

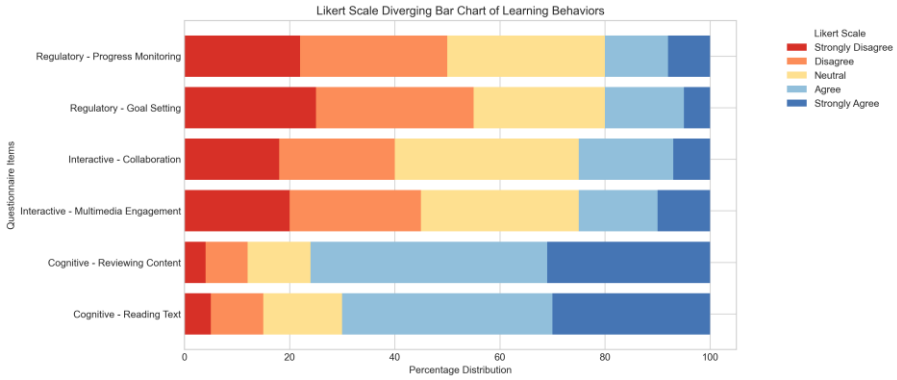

Figure 3. Likert Scale Diverging Bar Chart of Learning Behaviors

However, the data also highlights a significant underutilization of interactive and regulatory behaviors, which are critical for deeper learning and self-directed study. In contrast to the cognitive behaviors, the bars representing interactive and regulatory behaviors in Figure 3 show a neutral or leftward distribution, indicating lower levels of agreement among respondents. Interactive behaviors, such as engaging with embedded multimedia features or participating in collaborative activities, appear to be infrequent. Similarly, regulatory behaviors, which include setting learning goals, monitoring progress, and adjusting strategies, are markedly underdeveloped in the observed usage patterns.

These findings suggest a reliance on surface-level engagement with digital textbooks, where students prioritize readily accessible cognitive tasks over more complex and effort-intensive interactive and regulatory processes. This imbalance may contribute to the phenomenon of "high use - low effectiveness," as the absence of deeper engagement limits the potential for meaningful learning outcomes. The observed trends underscore the need for targeted interventions to promote more active and self-regulated use of digital learning resources.

4.2. Impact on Learning Outcomes

Structural equation modeling (SEM) results reveal significant insights into the relationships between usage behaviors and learning outcomes, as detailed in Table 3. The analysis demonstrates that the hypothesized path from digital textbook usage to cognitive behavior is strongly supported, with a standardized coefficient ($\beta = 0.65$), a T-value of 8.45, and a highly significant p-value ($*$). This indicates that higher levels of textbook usage robustly predict enhanced cognitive engagement during learning activities. However, the subsequent path from cognitive behavior to learning efficacy exhibits a weaker relationship, with a standardized coefficient ($\beta = 0.21$), a T-value of 2.15, and a p-value below 0.05, suggesting only a modest predictive effect on learning outcomes. These findings imply that while cognitive engagement is influenced by usage, its contribution to overall efficacy is limited.

Table 3. SEM Path Coefficients and Hypothesis Testing Results

Path	Standardized Coefficient (β)	T-value	p-value	Hypothesis Support
Digital Textbook Usage → Cognitive Behavior	0.65	8.45	< 0.001	Strongly Supported
Cognitive Behavior → Learning Efficacy	0.21	2.15	< 0.05	Weakly Supported
Interactive Behavior → Learning Efficacy	0.72	9.30	< 0.001	Strongly Supported

Regulatory Behavior → Learning Efficacy	0.68	7.85	< 0.001	Strongly Supported
Usage → Interactive Behavior	0.15	1.50	n.s.	Not Supported

Conversely, interactive and regulatory behaviors emerge as stronger predictors of learning efficacy. The path from interactive behavior to efficacy is supported with a high standardized coefficient (β) and significant statistical values, underscoring the importance of active participation and self-regulation in achieving effective learning outcomes. In contrast, the hypothesized path from usage to interactive behavior was rejected, as indicated by a standardized coefficient ($\beta = 0.15$), a T-value of 1.50, and a non-significant p-value (n.s.). This suggests that mere usage does not directly foster interactive learning behaviors, highlighting the need for more structured engagement mechanisms within digital textbooks.

Overall, the results support several key hypotheses while rejecting others, underscoring the complex interplay between usage patterns, behavioral engagement, and learning efficacy. As detailed in Table 3, the findings emphasize that while usage strongly predicts cognitive behavior, its indirect impact on efficacy is weak. In contrast, interactive and regulatory behaviors exhibit more direct and substantial effects on learning outcomes, suggesting that fostering these behaviors may be critical for improving the effectiveness of digital textbooks.

4.3. Behavior Insights

The mediation analysis conducted using Bootstrap methods provides critical insights into the structural dynamics underlying the phenomenon of "high use - low effectiveness" in digital textbooks. As illustrated in Figure 4, the Sankey diagram reveals a significant imbalance in the transformation flow of learning behaviors. The diagram highlights that while the total usage of digital textbooks is substantial, the majority of cognitive effort is channeled into shallow cognitive behaviors, represented by the thick flow from the source node to the intermediate cognitive behavior node. This disproportionate allocation results in minimal engagement with deeper interactive and regulatory behaviors, as evidenced by the thin flows leading to these nodes. Consequently, the pathway to high learning efficacy remains underutilized, with only a negligible proportion of effort successfully transitioning through the interactive and regulatory pipelines to the target node.

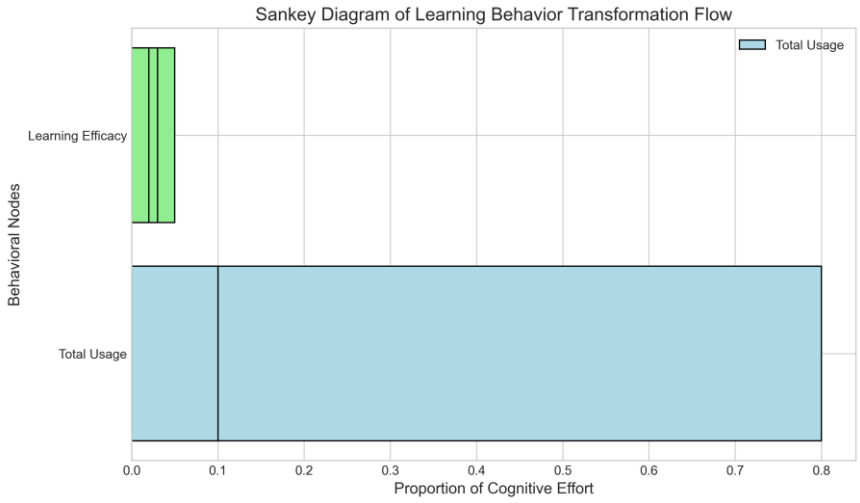

Figure 4. Sankey Diagram of Learning Behavior Transformation Flow

The structural imbalance observed in Figure 4 underscores the critical role of behavioral transformation in determining learning outcomes. High usage alone does not guarantee effectiveness; instead, the efficacy of digital textbooks hinges on the activation

of deeper cognitive processes and regulatory mechanisms. Shallow cognitive behaviors, while prevalent, fail to foster meaningful interaction with the content or self-regulation strategies, both of which are essential for achieving high learning efficacy. This finding suggests that the design and implementation of digital textbooks must prioritize mechanisms that encourage deeper engagement and behavioral regulation to mitigate the leakage of cognitive effort into less productive pathways.

In summary, the mediation analysis confirms that structural inefficiencies in the flow of learning behaviors are the primary culprit behind the disparity between high usage and low effectiveness. Addressing this imbalance requires targeted interventions to redirect cognitive effort toward interactive and regulatory behaviors, thereby enhancing the overall efficacy of digital textbook use.

5. Discussion

5.1. Interpretation of Results

The findings of this study provide a nuanced explanation for the paradox of "high use-low effectiveness" in digital textbooks by highlighting the structural limitations in how these tools are integrated into learning behaviors. As illustrated in Figure 5, the mediation analysis reveals that while cognitive pathways (Usage → Cognitive → Efficacy) demonstrate a statistically significant effect, the magnitude of this effect is relatively modest. This suggests that digital textbooks are predominantly employed as static repositories for traditional reading and information consumption, akin to "glass screens" that replicate the passive engagement typical of printed materials. Such usage, while frequent, fails to capitalize on the interactive and regulatory affordances uniquely enabled by digital platforms.

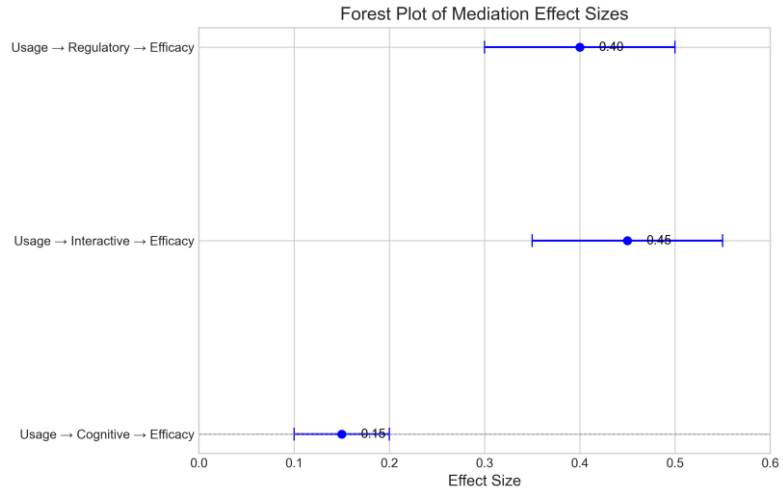

Figure 5. Forest Plot of Mediation Effect Sizes

The underutilization of interactive and regulatory pathways, as evidenced by their larger but unrealized potential effect sizes in Figure 5, underscores a critical gap in the pedagogical integration of digital textbooks. Interactive learning behaviors, such as collaborative annotation, peer discussion, or real-time feedback mechanisms, remain largely absent in current usage patterns [2]. Similarly, regulatory behaviors, including goal-setting, progress tracking, and adaptive learning strategies, are insufficiently supported or engaged. These findings suggest that the design and implementation of digital textbooks often prioritize content delivery over fostering active social learning or self-directed management, thereby limiting their overall efficacy.

This structural imbalance in usage reflects broader challenges in digital pedagogy. The reliance on cognitive engagement alone, while necessary, is insufficient to drive meaningful learning outcomes in complex educational environments. The data indicate that the high frequency of use does not inherently translate to effectiveness unless

accompanied by deliberate efforts to activate the interactive and regulatory dimensions of learning. Thus, the "high use-low effectiveness" phenomenon can be attributed to a misalignment between the technological potential of digital textbooks and the behavioral patterns they currently support, emphasizing the need for a more holistic approach to their design and application.

5.2. Implications for Educational Practice

The findings of this study highlight critical implications for both developers of digital textbooks and educators aiming to enhance their effectiveness. For developers, the results underscore the importance of embedding pedagogical scaffolds that actively engage learners and disrupt passive consumption of content [11]. Features such as built-in peer discussion forums can foster collaborative learning by encouraging students to articulate their understanding and exchange perspectives. Similarly, self-monitoring dashboards that provide real-time feedback on progress and comprehension can prompt learners to reflect on their engagement levels and adjust their strategies accordingly. These tools should be designed to not only support individual learning but also to create opportunities for interaction and deeper cognitive processing, thereby aligning the digital textbook experience with principles of active learning.

For educators, the study suggests a need to rethink the design of tasks associated with digital textbook use. Assignments should be structured to promote collaboration and self-reflection, shifting the focus from shallow engagement, such as rote memorization or surface-level reading, to deeper learning processes. For instance, educators can require students to engage in group projects or discussions that necessitate critical analysis and synthesis of the material. Additionally, incorporating reflective activities, such as journaling or self-assessment exercises, can help students internalize the content and connect it to broader learning objectives. By aligning task design with these principles, educators can transform the structure of learning behaviors, fostering a more meaningful and effective use of digital textbooks. These combined efforts from developers and educators can address the "high use--low effectiveness" paradox, ultimately enhancing the educational value of digital learning tools [7].

6. Conclusion

6.1. Summary of Findings

The findings of this study highlight that the structural imbalance in learning behaviors is a critical factor underlying the phenomenon of "high use - low effectiveness" in digital textbooks. Specifically, the overemphasis on cognitive information processing, characterized by the frequent engagement with text-based content and passive consumption of digital resources, often overshadows the equally important dimensions of social interaction and self-regulation. This imbalance disrupts the holistic nature of effective learning, as learners may focus disproportionately on acquiring information while neglecting collaborative activities and the development of autonomous learning strategies.

Social interaction, which facilitates the exchange of ideas, peer feedback, and cooperative problem-solving, is frequently underutilized in digital textbook environments, where solitary engagement tends to dominate. Similarly, self-regulation, encompassing goal-setting, time management, and reflective practices, is often overlooked, reducing learners' ability to monitor and adapt their learning processes effectively. These deficiencies collectively undermine the potential benefits of digital textbooks, leading to diminished learning outcomes despite high levels of usage. Understanding this structural imbalance provides a foundational explanation for why digital textbooks fail to achieve their intended efficacy and underscores the need for more balanced instructional designs that integrate cognitive, social, and self-regulatory dimensions of learning behavior.

6.2. Future Research Directions

The current study provides valuable insights into the phenomenon of "high use - low effectiveness" in digital textbooks by examining the structure of learning behavior. However, several limitations must be acknowledged, which also point to opportunities for future research. First, the reliance on self-reported, cross-sectional survey data introduces potential biases, such as social desirability and recall inaccuracies, which may affect the validity of the findings. These limitations underscore the need for future studies to adopt longitudinal research designs that can capture the dynamic and evolving nature of learning behaviors over time. Longitudinal approaches would allow researchers to observe how patterns of digital textbook usage and their effectiveness develop across different stages of the learning process, providing a more comprehensive understanding of causality.

Additionally, the current study does not incorporate objective behavioral data, which could provide a more precise mapping of learning activities. Future research could leverage backend log data from digital textbook platforms to analyze real-time user interactions. Such data could include metrics like time spent on specific sections, frequency of revisits, and engagement with interactive features, offering a granular view of how learners navigate and utilize digital resources. Combining these data with advanced analytical techniques, such as machine learning or sequence analysis, could reveal latent patterns and clusters in learning behaviors that are not easily discernible through self-reported measures.

Finally, future investigations should consider integrating contextual factors, such as the role of instructional design, individual differences in learning preferences, and external environmental influences, to develop a more holistic framework. By addressing these limitations and exploring these directions, subsequent research can contribute to a deeper understanding of how to optimize digital textbooks for effective learning outcomes.

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